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INFLUENCE OF THINNING ON SAPWOOD
RELATIONSHIPS OF LODGEPOLE PINE

CO-OP AGREEMENT

UTAH STATE
UNIVERSITY

FINAL REPORT FOR RESEARCH JOINT VENTURE AGMT

#INT-89-407-RJVA with

UTAH STATE UNIVERSITY

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**INFLUENCE OF THINNING ON SAPWOOD RELATIONSHIPS
OF LODGEPOLE PINE**

by Michael J. Jenkins

Final Report for Research Joint Venture Agreement INT-89407-RJVA

Introduction

The long term objectives of this research are to characterize the degree of susceptibility to MPB hazard of the various partial and intermediate cutting practices in lodgepole pine stands varying in form, age, composition and density. Of major interest in the final analysis of these data is validity of using stand density index as a measure of stand susceptibility. The data obtained in this study clearly show the relationship between stand density and sapwood and phloem production. These are the principle biological tree and stand characteristics affecting tree resistance or susceptibility to bark beetles.

The two specific objectives of this Research Joint Venture were:

1. to investigate correlations of various transforms of sapwood depth, with tree and stand variables measured as indicators of tree and stand vigor.
2. to determine patterns of sapwood area and depth for comparable tree classes in the same time periods before and after thinning, in thinned and unthinned stands.

Methods

Compartment exam data on file in USFS offices were analyzed to locate previously thinned stands that allowed access to a similar, unthinned stand nearby. Using this approach 27 pairs of stands were located and long term evaluation plots established. Location of stands and data collected were discussed in the plot establishment portion of this study previously submitted.

Results

Objective 1

Table 1 shows a pair wise comparison of various transforms of sapwood depth and tree and stand variables. Phloem thickness, tree height, crown length, the number of years since a mountain pine beetle outbreak and the number of years since thinning are all positively correlated with various measures of sapwood depth.

Objective 2

The means and standard deviations for the various transforms of sapwood depth for thinned and unthinned stands are in Appendix A. Of the measures presented in the Appendix six were shown to be significantly different for thinned and control stands:

1. width of the current year's ring (WLR)
2. width of the five rings prior to the current year (WL5R)
3. width of the five rings prior to WL5R (WP5R)
4. width of all rings from the year prior to thinning to WLR (RDT)
5. width of the first five rings after thinning (TR1-5)
6. width of the second five rings after thinning (TR6-10)

DISCUSSION

Objective 1

The results of this study show that phloem thickness, diameter and crown length are the variables most closely correlated with sapwood depth. These are also the most commonly used variables in developing systems to hazard rate stands to attack by MPB.

It is intuitive that as sapwood depth increases so will phloem thickness since additional photosynthate will be required to support the living cells in the sapwood. It also seems logical to assume that as phloem and sapwood thickness increase, tree vigor, however this is measured, will increase correspondingly. However, thick phloem will optimize beetle brood production in trees that are attacked. If we accept the notion that phloem and sapwood thickness are correlated with tree vigor then this study has determined useful, measurable variables that can be used as indicators of sapwood depth hence tree resistance to MPB.

Objective 2

It is not especially enlightening to find that thinning will result in increased sapwood on the leave trees. This was clearly demonstrated in this study in showing that all measures of sapwood depth were greater in thinned than in nonthinned stands. It is interesting to note that response occurs in the first five years as shown by the significant difference in the TR15 value in thinned versus nonthinned stands. Thus if sapwood depth and phloem thickness are measures of tree resistance as described above we can expect this effect to occur within the first five years post thinning. These same results are shown in Table 1 which shows YST

to be positively correlated with most measures of sapwood depth. Outbreaks may function as thinning by reducing competitive interaction and indeed the RDO value is correlated with outbreaks. However, YSO is also correlated with OC5 and OP5 which may indicate that faster growing trees not killed in outbreaks may be those correlated with RDO. Perhaps these are resistant trees, but at best this is difficult relationship to interpret at present.

In conclusion I believe these results support my hypothesis established at the outset; namely that stand density indices are the most appropriate measures of stand susceptibility to MPB.

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Table 1. Significantly different independent-dependent variable pairs determined using the REGWQ multiple comparison procedure.

Independent Variable	Dependent Variable
ERN	WLR, WL5R, WP5R, RDT, TR15, SWR
ERS	WLR, WL5R, WP5R, RDT, TR15, SWR, TC5, BHAGE
PT1	WLR, WL5R, WP5R, RDT, TR15, TC5, SWR
PT2	WLR, WL5R, WP5R, RDT, TR15, TC5, SWR, TR610, TP5
CL	OC5, OP5, WL5R, WP54, RDT, TR15, TC5, TP5, SWR
CON1	RDO, WL5R, WP5R, TR15, TC5, TC5, TP5, SWR
CON2	RDO, OC5, WL5R
YSO	RDO, OC5, OP5
YST	WLR, RDO, OC5, OP5, WL5R, RDT, TR610, TR610, TR15, TC5, TP5
DBH	SWR, BHAGE
DSH	SWR, BHAGE

APPENDIX A

Means and standard deviations for transforms of sapwood depth for thinned and unthinned stands.

----- SN=42 ST=0			
N Obs	Variable	Mean	Std Dev
12	WLR	0.6867	0.2789
	RDO	1.4283	0.6476
	OC5	3.2433	1.3677
	OD5	3.1158	1.0823
	WL5R	3.3583	1.4323
	WP5R	3.2117	1.1044
	RDT	6.0950	2.3404
	TR610	2.0808	0.8804
	TR15	3.2525	1.2477
	TC5	3.1742	1.1286
	TP5	3.7800	0.9979
	SWR	38.5975	7.4752
	BHAGE	71.6667	11.9418

----- SN=42 ST=1			
N Obs	Variable	Mean	Std Dev
16	WLR	1.3150	0.3457
	RDO	3.1394	0.7573
	OC5	7.1937	1.6526
	OD5	6.8675	1.5877
	WL5R	7.3400	1.6391
	WP5R	6.9800	1.6269
	RDT	12.6137	3.0557
	TR610	4.1400	1.1555
	TR15	7.2313	1.6629
	TC5	6.9894	1.6630
	TP5	9.7275	3.4125
	SWR	47.7269	13.8692
	BHAGE	69.9375	14.0924

----- SN=43 ST=0			
N Obs	Variable	Mean	Std Dev
6	WLR	0.6733	0.2545
	RDO	3.0800	1.1862
	OC5	3.5083	1.0946
	OD5	4.0683	1.3247
	WL5R	3.8117	1.3579
	WP5R	3.5433	1.1656
	RDT	7.2950	2.4959
	TR610	3.1350	1.1907
	TR15	3.3750	1.0827
	TC5	4.0717	1.4209
	TP5	4.1417	1.3553
	SWR	31.3417	12.1530
	BHAGE	66.0000	1.5492

----- SN=43 ST=1			
N Obs	Variable	Mean	Std Dev

17	WLR	1.4524	0.8099
	RDO	5.8100	2.3318
	OC5	6.9600	3.0293
	OD5	6.6524	3.3307
	WL5R	7.2488	2.8992
	WP5R	6.9018	2.9519
	RDT	14.1718	5.8650
	TR610	5.8318	2.3283
	TR15	6.9600	3.0599
	TC5	6.6800	3.2420
	TP5	7.8312	3.4678
	SWR	46.8618	16.4849
	BHAGE	81.0000	13.7931

----- SN=44 ST=0			
N Obs	Variable	Mean	Std Dev

6	WLR	0.7283	0.2084
	RDO	3.6183	0.7976
	OC5	4.1233	0.6180
	OD5	3.7233	0.7677
	WL5R	4.5567	0.9696
	WP5R	3.9183	0.5933
	RDT	16.3333	2.4482
	TR610	3.9350	0.5687
	TR15	3.9733	0.8049
	TC5	3.9000	0.9120
	TP5	4.1467	0.6081
	SWR	39.1417	5.4442
	BHAGE	80.6667	2.7325

----- SN=44 ST=1			
N Obs	Variable	Mean	Std Dev

16	WLR	1.0613	0.4474
	RDO	4.8088	1.5985
	OC5	5.8269	2.6465
	OD5	6.4881	3.0055
	WL5R	5.9769	2.1223
	WP5R	5.9694	2.7576
	RDT	26.4675	11.6676
	TR610	6.5175	2.9960
	TR15	8.1400	4.5263
	TC5	4.7894	1.8772
	TP5	4.2569	1.5255
	SWR	41.0337	9.4628
	BHAGE	79.8125	20.9610

----- SN=45 ST=1			
N Obs	Variable	Mean	Std Dev
16	WLR	1.1494	0.4471
	RDO	4.6381	1.7750
	OC5	5.2062	1.8178
	OD5	5.9350	2.1589
	WL5R	5.7444	2.1665
	WP5R	5.4031	1.8871
	RDT	24.3188	8.0432
	TR610	6.2519	2.2457
	TR15	7.0663	2.6054
	TC5	5.2894	1.7083
	TP5	5.4012	1.4918
	SWR	52.0369	16.4746
	BHAGE	82.7500	8.3307

----- SN=46 ST=0			
N Obs	Variable	Mean	Std Dev
7	WLR	0.6486	0.2644
	RDO	1.3957	0.5237
	OC5	3.5486	1.2369
	OD5	3.4300	1.2361
	WL5R	3.6143	1.2907
	WP5R	3.4086	1.1998
	RDT	15.2186	5.1253
	TR610	3.4657	1.2969
	TR15	3.8600	1.3428
	TC5	3.8471	1.3780
	TP5	3.6600	1.0647
	SWR	34.4757	8.7528
	BHAGE	65.5714	1.7182

----- SN=46 ST=1			
N Obs	Variable	Mean	Std Dev
18	WLR	1.2689	0.4883
	RDO	2.5517	0.8942
	OC5	6.2383	1.9431
	OD5	6.0156	2.2782
	WL5R	6.1611	1.9097
	WP5R	6.1589	2.2097
	RDT	26.2372	9.0540
	TR610	6.0083	2.2444
	TR15	6.5522	3.0401
	TC5	4.3556	1.1792
	TP5	4.6717	1.1390
	SWR	38.9483	8.2862

BHAGE 73.2778 12.2801

----- SN=47 ST=0

N Obs	Variable	Mean	Std Dev
6	WLR	0.9800	0.4310
	RDO	2.2350	1.0192
	OC5	5.3267	2.3783
	OD5	4.7550	1.8764
	WL5R	5.5617	2.5425
	WP5R	4.8467	2.0456
	RDT	4.1700	1.9219
	TR610	0.0000	0.0000
	TR15	3.0133	1.3847
	TC5	4.6400	1.7927
	TP5	4.9817	1.8705
	SWR	41.0283	11.2366
	BHAGE	67.0000	3.0332

----- SN=47 ST=1

N Obs	Variable	Mean	Std Dev
16	WLR	1.2450	0.5396
	RDO	2.7737	1.0570
	OC5	6.8956	2.4860
	OD5	7.3319	3.1626
	WL5R	6.6950	2.5267
	WP5R	6.9363	2.7234
	RDT	5.4413	1.9944
	TR610	0.0031	0.0101
	TR15	5.1463	2.0416
	TC5	6.8294	2.4834
	TP5	7.5556	3.3723
	SWR	44.4788	12.7299
	BHAGE	67.2500	8.8957

----- SN=48 ST=0

N Obs	Variable	Mean	Std Dev
7	WLR	0.6771	0.2205
	RDO	0.0014	0.0038
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	4.9957	2.0599
	WP5R	5.8771	2.3398
	RDT	7.4643	2.9809
	TR610	0.9586	0.4399
	TR15	5.4071	2.1763
	TC5	6.0871	2.5644
	TP5	5.8971	2.0967

SWR	59.8943	21.1120
BHAGE	61.0000	5.8310

----- SN=48 ST=1			
N Obs	Variable	Mean	Std Dev
13	WLR	0.9338	0.3762
	RDO	0.0008	0.0028
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	6.2054	2.9932
	WP5R	4.3508	2.1455
	RDT	8.0815	3.8543
	TR610	1.5454	0.7689
	TR15	5.7562	2.7330
	TC5	4.4285	2.0667
	TP5	4.2854	1.5840
	SWR	44.7238	13.3492
	BHAGE	63.4615	4.3131

----- SN=49 ST=0			
N Obs	Variable	Mean	Std Dev
8	WLR	0.8600	0.3271
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	4.6913	1.7220
	WP5R	4.9925	1.8289
	RDT	6.5438	2.4687
	TR610	0.9087	0.3877
	TR15	4.7438	1.8136
	TC5	5.1100	2.3710
	TP5	4.6688	2.0079
	SWR	49.2225	25.9864
	BHAGE	55.0000	20.7020

----- SN=49 ST=1			
N Obs	Variable	Mean	Std Dev
13	WLR	1.2362	0.4578
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.9623	2.1817
	WP5R	5.4169	1.9239
	RDT	8.0777	2.9152
	TR610	1.2738	0.4802
	TR15	5.8823	2.1641
	TC5	5.6015	1.8385

TP5	5.5277	1.3944
SWR	47.2808	13.2488
BHAGE	56.3077	6.4470

----- SN=50 ST=0

N Obs	Variable	Mean	Std Dev
4	WLR	0.6700	0.0271
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	6.2800	1.7311
	WP5R	8.0275	2.4868
	RDT	9.4500	2.5521
	TR610	1.0000	0.1417
	TR15	7.0450	2.0730
	TC5	9.1575	3.0987
	TP5	8.6050	2.1235
	SWR	60.9925	14.6800
	BHAGE	57.2500	6.1847

----- SN=50 ST=1

N Obs	Variable	Mean	Std Dev
15	WLR	1.3093	0.3650
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	7.5220	2.2184
	WP5R	5.0020	1.5886
	RDT	9.9887	2.6905
	TR610	1.5247	0.4505
	TR15	7.5060	2.1472
	TC5	4.5747	1.5499
	TP5	3.9873	1.3864
	SWR	41.0067	11.0493
	BHAGE	60.2667	8.6806

----- SN=51 ST=0

N Obs	Variable	Mean	Std Dev
7	WLR	0.8714	0.3277
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.7829	2.8881
	WP5R	6.3757	2.9854
	RDT	8.5357	4.7246
	TR610	1.0600	0.6544
	TR15	6.3129	3.3745

TC5	6.4071	2.4653
TP5	6.4500	2.4379
SWR	52.9157	15.7071
BHAGE	60.7143	4.4240

----- SN=51 ST=1

N Obs	Variable	Mean	Std Dev
17	WLR	1.0882	0.2072
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	8.3188	1.2802
	WP5R	5.6806	1.4285
	RDT	10.9388	1.8943
	TR610	1.7647	0.3593
	TR15	8.1076	1.4715
	TC5	5.0953	1.1036
	TP5	4.6000	1.0838
	SWR	43.0382	10.0914
	BHAGE	57.7059	3.8367

----- SN=52 ST=0

N Obs	Variable	Mean	Std Dev
8	WLR	0.6375	0.3155
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	4.4200	1.7124
	WP5R	5.0975	2.3059
	RDT	9.6100	3.9927
	TR610	3.4087	1.3270
	TR15	5.3100	2.4319
	TC5	4.9325	2.2501
	TP5	4.5737	1.8549
	SWR	33.0163	11.0883
	BHAGE	50.8750	2.6424

----- SN=52 ST=1

N Obs	Variable	Mean	Std Dev
13	WLR	1.1092	0.4468
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	7.7900	2.9559
	WP5R	9.4192	2.6851
	RDT	17.2400	5.5787
	TR610	5.9623	2.2521

TR15	9.8608	3.0296
TC5	6.0985	1.5073
TP5	5.8708	1.8173
SWR	38.0408	10.0758
BHAGE	50.5385	2.4364

----- SN=53 ST=0

N Obs	Variable	Mean	Std Dev
6	WLR	0.8383	0.2088
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.3317	1.9017
	WP5R	4.5283	1.1642
	RDT	4.5467	1.6352
	TR610	0.0000	0.0000
	TR15	3.7450	1.3309
	TC5	4.2083	1.1793
	TP5	5.9300	1.1521
	SWR	41.5850	7.6284
	BHAGE	58.8333	1.3292

----- SN=53 ST=1

N Obs	Variable	Mean	Std Dev
6	WLR	1.6767	0.6954
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	9.1667	2.4413
	WP5R	5.1000	1.6270
	RDT	8.3217	2.2392
	TR610	0.0000	0.0000
	TR15	7.4183	2.1522
	TC5	5.0133	1.8820
	TP5	5.6733	1.3334
	SWR	39.7683	9.4043
	BHAGE	58.6667	2.0656

----- SN=54 ST=0

N Obs	Variable	Mean	Std Dev
8	WLR	0.7112	0.4320
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.9987	2.1788
	WP5R	4.3138	2.3808
	RDT	9.3700	5.0475

TR610	4.0075	2.0818
TR15	4.3725	2.4446
TC5	4.2200	2.1059
TP5	5.0000	2.4470
SWR	31.4700	19.2772
BHAGE	60.3750	9.3188

----- SN=54 ST=1

N Obs	Variable	Mean	Std Dev
10	WLR	1.3820	0.3681
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	10.3860	2.2624
	WP5R	8.6740	2.1559
	RDT	20.6470	4.5612
	TR610	10.3990	2.2545
	TR15	8.6850	2.1511
	TC5	6.6190	1.4562
	TP5	7.7660	1.9026
	SWR	62.5570	13.3887
	BHAGE	65.0000	2.0548

----- SN=55 ST=0

N Obs	Variable	Mean	Std Dev
6	WLR	0.7017	0.3318
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	4.2300	2.3502
	WP5R	3.7700	1.6556
	RDT	4.2050	2.3307
	TR610	0.0000	0.0000
	TR15	3.3450	1.9237
	TC5	3.7567	1.7114
	TP5	3.4600	1.5722
	SWR	36.9600	12.1058
	BHAGE	85.1667	3.7103

----- SN=55 ST=1

N Obs	Variable	Mean	Std Dev
10	WLR	0.8770	0.4638
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.1550	2.9135
	WP5R	5.9950	4.1634

RDT	5.1510	2.9020
TR610	0.0000	0.0000
TR15	4.0950	2.2643
TC5	5.9550	4.1995
TP5	5.8950	3.3657
SWR	44.1650	16.2578
BHAGE	84.1000	4.2019

----- SN=56 ST=0

N Obs	Variable	Mean	Std Dev
6	WLR	0.5500	0.1342
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.2317	0.7480
	WP5R	3.4617	0.9641
	RDT	14.8067	2.4439
	TR610	2.8283	0.5860
	TR15	3.6817	0.3972
	TC5	6.0317	0.9949
	TP5	8.3767	1.3290
	SWR	25.8383	5.1536
	BHAGE	42.3333	1.2111

----- SN=56 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	1.4083	0.2611
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	8.4600	1.8171
	WP5R	11.4975	2.0794
	RDT	52.0708	9.4924
	TR610	13.4467	2.6374
	TR15	13.8825	3.5537
	TC5	11.5500	2.7836
	TP5	15.1550	4.4450
	SWR	60.2433	11.3133
	BHAGE	39.0833	1.3114

----- SN=57 ST=0

N Obs	Variable	Mean	Std Dev
8	WLR	0.6550	0.3490
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.8900	2.3970

WP5R	4.5850	2.4322
RDT	6.5663	3.9461
TR610	1.3400	0.8411
TR15	4.4625	2.6756
TC5	4.4612	2.5523
TP5	4.8775	3.1738
SWR	34.1250	11.9670
BHAGE	40.5000	4.9570

----- SN=57 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	2.8133	0.7071
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	16.7225	4.7200
	WP5R	6.9058	4.1624
	RDT	21.5358	6.7184
	TR610	6.7892	2.0873
	TR15	13.6308	5.1998
	TC5	5.3325	4.3436
	TP5	4.9333	4.8190
	SWR	42.2350	14.0148
	BHAGE	39.7500	2.1373

----- SN=58 ST=0

N Obs	Variable	Mean	Std Dev
6	WLR	0.8717	0.3246
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.0217	2.0013
	WP5R	6.8667	1.2741
	RDT	4.9900	1.9738
	TR610	0.0000	0.0000
	TR15	3.9367	1.7025
	TC5	6.7617	1.3303
	TP5	7.2333	0.8402
	SWR	41.0167	8.8252
	BHAGE	42.5000	0.5477

----- SN=58 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	2.1917	0.6861
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000

WL5R	7.1975	2.1476
WP5R	5.0867	1.6864
RDT	7.2050	2.1467
TR610	0.0000	0.0000
TR15	6.3275	1.9522
TC5	5.0483	1.5869
TP5	5.0842	1.2236
SWR	33.9633	5.4874
BHAGE	41.6667	1.6143

----- SN=59 ST=0

N Obs	Variable	Mean	Std Dev
8	WLR	0.5937	0.3351
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.0525	1.8734
	WP5R	3.3512	1.8323
	RDT	1.7963	1.1132
	TR610	0.0000	0.0000
	TR15	1.1163	0.6648
	TC5	3.1637	2.0761
	TP5	3.2212	1.4261
	SWR	28.1813	9.8122
	BHAGE	48.8750	8.0256

----- SN=59 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	3.1658	1.1145
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	11.4592	4.8745
	WP5R	4.4108	1.1193
	RDT	8.9900	3.9459
	TR610	0.0000	0.0000
	TR15	6.7525	2.8650
	TC5	5.2875	1.7012
	TP5	3.9808	0.6466
	SWR	37.0983	6.4354
	BHAGE	53.0000	2.4495

----- SN=60 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	1.8475	0.5227
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000

OD5	0.0000	0.0000
WL5R	7.9758	2.5368
WP5R	6.2158	2.6908
RDT	7.9867	2.5557
TR610	0.0000	0.0000
TR15	6.6008	2.0795
TC5	6.1925	2.7070
TP5	5.0742	2.2167
SWR	30.5567	5.8899
BHAGE	41.5000	1.3817

----- SN=61 ST=0

N Obs	Variable	Mean	Std Dev
12	WLR	0.6367	0.3233
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.7117	1.8423
	WP5R	4.0342	1.7913
	RDT	21.9117	7.2768
	TR610	4.4100	1.4230
	TR15	5.6817	1.7895
	TC5	6.6667	2.5821
	TP5	8.2917	3.3867
	SWR	39.3208	12.1643
	BHAGE	55.6667	3.6013

----- SN=61 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	0.6925	0.2468
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.9500	1.5838
	WP5R	4.6250	1.6715
	RDT	23.5508	8.1263
	TR610	4.8108	1.7864
	TR15	5.8742	1.9893
	TC5	6.5675	1.9394
	TP5	7.5958	1.9844
	SWR	45.3242	8.1255
	BHAGE	58.0000	3.9312

----- SN=62 ST=0

N Obs	Variable	Mean	Std Dev
12	WLR	0.3508	0.1873
	RDO	0.0000	0.0000

OC5	0.0000	0.0000
OD5	0.0000	0.0000
WL5R	2.5308	1.4839
WP5R	2.5592	1.5269
RDT	3.0558	1.7723
TR610	0.0000	0.0000
TR15	2.5450	1.4839
TC5	2.5775	1.3774
TP5	2.6842	1.3872
SWR	38.3808	10.4209
BHAGE	127.7500	14.6668

----- SN=62 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	0.9250	0.3024
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	6.3050	1.9164
	WP5R	4.4525	1.0516
	RDT	7.1800	2.0161
	TR610	0.0000	0.0000
	TR15	6.3208	1.9186
	TC5	4.6425	1.1229
	TP5	5.5658	1.1976
	SWR	63.1775	15.0949
	BHAGE	74.9167	6.1268

----- SN=63 ST=0

N Obs	Variable	Mean	Std Dev
16	WLR	0.4863	0.4221
	RDO	3.9869	2.5446
	OC5	1.6419	0.9444
	OD5	1.9794	1.0397
	WL5R	2.8288	1.9399
	WP5R	1.8181	1.0095
	RDT	5.8144	3.4774
	TR610	2.2550	1.6603
	TR15	1.7113	1.0269
	TC5	1.9500	1.0433
	TP5	2.2706	1.2748
	SWR	29.3438	10.4689
	BHAGE	96.8125	10.4895

----- SN=63 ST=1

N Obs	Variable	Mean	Std Dev
15	WLR	0.6547	0.3049

RDO	6.3667	3.3413
OC5	3.5027	2.5532
OD5	2.6473	1.3515
WL5R	4.1933	2.0044
WP5R	3.5613	2.4572
RDT	10.4793	6.1301
TR610	3.8620	2.3222
TR15	3.4607	2.5606
TC5	2.5953	1.2501
TP5	2.1340	0.8564
SWR	34.5300	13.0301
BHAGE	101.7333	5.2978

----- SN=64 ST=0

N Obs	Variable	Mean	Std Dev
16	WLR	0.4019	0.1375
	RDO	1.5069	0.4826
	OC5	1.7244	0.5489
	OD5	1.7825	0.6940
	WL5R	1.8563	0.6037
	WP5R	1.6875	0.5768
	RDT	5.3031	1.6831
	TR610	1.8250	0.6126
	TR15	1.7956	0.6647
	TC5	1.7550	0.6309
	TP5	1.7813	0.5384
	SWR	34.2119	12.9021
	BHAGE	119.8125	4.6364

----- SN=64 ST=1

N Obs	Variable	Mean	Std Dev
16	WLR	0.7806	0.4304
	RDO	3.3344	2.4087
	OC5	3.9062	3.2169
	OD5	3.0525	1.8271
	WL5R	4.1875	3.1007
	WP5R	3.7044	2.9732
	RDT	10.7906	7.5800
	TR610	3.9156	3.2120
	TR15	3.0662	1.8481
	TC5	2.5494	1.1605
	TP5	2.7906	1.2096
	SWR	39.3250	12.1988
	BHAGE	114.7500	18.1787

----- SN=65 ST=0

N Obs	Variable	Mean	Std Dev
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15	WLR	0.5107	0.3026
	RDO	1.7720	1.1844
	OC5	2.1820	1.4010
	OD5	2.3060	1.5333
	WL5R	3.0440	1.8668
	WP5R	2.9020	1.3938
	RDT	8.1147	3.8226
	TR610	3.1060	1.5550
	TR15	3.0247	1.2469
	TC5	2.9453	1.5044
	TP5	3.1140	1.8457
	SWR	36.3880	16.3506
	BHAGE	110.5333	15.9323

----- SN=65 ST=1

N Obs	Variable	Mean	Std Dev
12	WLR	0.9817	0.4155
	RDO	3.7200	1.6099
	OC5	3.4008	1.1679
	OD5	3.8250	1.3794
	WL5R	4.3908	1.7063
	WP5R	3.3575	1.0956
	RDT	6.4542	2.3133
	TR610	2.0175	0.7780
	TR15	3.7792	1.4047
	TC5	3.7775	1.3060
	TP5	3.8517	1.2656
	SWR	44.7892	15.9298
	BHAGE	93.5833	14.2794

----- SN=66 ST=0

N Obs	Variable	Mean	Std Dev
12	WLR	0.4892	0.1397
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	2.8492	0.9688
	WP5R	2.5575	0.9658
	RDT	7.3433	2.5791
	TR610	2.7533	1.0462
	TR15	2.5950	1.0093
	TC5	2.8533	0.9800
	TP5	2.8625	1.0834
	SWR	41.8833	18.4140
	BHAGE	111.1667	4.7450

----- SN=66 ST=1

N Obs	Variable	Mean	Std Dev
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12	WLR	0.9192	0.4633
	RDO	0.0008	0.0029
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	6.0917	4.4160
	WP5R	4.0392	2.8636
	RDT	10.1967	6.9673
	TR610	4.7908	3.4392
	TR15	4.9867	3.7574
	TC5	2.1125	0.7428
	TP5	1.9483	0.8307
	SWR	26.4608	16.1368
	BHAGE	104.2500	20.6755

----- SN=67 ST=0			
N Obs	Variable	Mean	Std Dev
14	WLR	0.5629	0.2006
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	3.0036	1.1561
	WP5R	2.4136	0.8240
	RDT	7.2586	2.4612
	TR610	2.7843	1.0829
	TR15	2.4586	0.7614
	TC5	2.6429	0.8498
	TP5	2.8829	1.0899
	SWR	40.2757	10.8397
	BHAGE	113.1429	3.6765

----- SN=67 ST=1			
N Obs	Variable	Mean	Std Dev
13	WLR	1.2415	0.3758
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	8.2662	2.9512
	WP5R	5.8092	4.0631
	RDT	15.7731	7.1052
	TR610	7.6638	3.8074
	TR15	4.0715	2.6210
	TC5	2.2754	1.0155
	TP5	2.1754	0.9404
	SWR	33.2915	13.8113
	BHAGE	111.4615	8.5305

----- SN=68 ST=0

N Obs	Variable	Mean	Std Dev
16	WLR	0.4931	0.1705
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	2.8744	1.0371
	WP5R	2.1144	0.9073
	RDT	6.5037	2.3410
	TR610	2.5962	1.1140
	TR15	2.0838	0.8301
	TC5	2.5500	1.1768
	TP5	2.2181	1.1501
	SWR	34.1956	9.9711
	BHAGE	116.2500	6.0056

----- SN=68 ST=1			
N Obs	Variable	Mean	Std Dev
15	WLR	0.8007	0.2951
	RDO	0.0000	0.0000
	OC5	0.0000	0.0000
	OD5	0.0000	0.0000
	WL5R	5.2200	1.4937
	WP5R	4.7493	1.8342
	RDT	11.5147	3.4366
	TR610	5.3853	1.6345
	TR15	3.7413	1.5619
	TC5	1.3827	0.4685
	TP5	1.2853	0.5155
	SWR	27.4187	9.2765
	BHAGE	114.7333	5.4178